

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT****ENGINEERING AND COMPLIANCE****APPLICATION PROCESSING AND CALCULATIONS**

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APPL. NO.

485404 and 486154

DATE:

09/11/08

PROCESSED BY

S. JIANG

CHECKED BY

D. GORDON

EVALUATION REPORT FOR PERMIT TO OPERATE**Applicant's Name:** THE PQ CORP

Facility ID: 011435

Mailing Address: 8401 QUARTZ AVE
SOUTH GATE, CALIFORNIA 90280**Equipment Location:** SAME

Modifications are shown in bold italic, original in bold strike-through.

APPLICATION NO. 485404 – Modify the open hearth furnace (D18) (PO No. F6965)

1. Addition of a blower and 20 air lances to change the furnace from single stage to dual stage firing.

Equipment	ID No.	Connected to	RECLAIM Source Type/ Monitoring Unit	Emission and Requirements	Conditions
Process 2: FURNACE					
System 2: SOLID SODIUM MELTING FURNACE					
FURNACE, MELTING, (TOTAL OF 12 BURNERS), NATURAL GAS, WITH TWO REGENERATORS AND 20 OVERFIRE AIR PORTS , 56.6 MMBTU/HR A/N: 325003 485404	D18		NOX: MAJOR SOURCE**	CO: 2000 PPMV NATURAL GAS (5) [RULE 407, 4-2-1982]; PM: 0.1 GRAINS/SCF (5A) [RULE 409, 8-7-1981]; PM: (9) [RULE 404, 2-7-1986 RULE 405, 2-7-1986]; PM: (8) [40CFR 60 Subpart CC, 10-17-2000]	A63.2, B59.1, B59.2, D29.1 , C1.4, D323.1, E193.1

APPLICATION NO. 486154: FACILITY PERMIT REVISION**PERMIT CONDITIONS**

The following Permit Conditions are added:

D29.1 The operator shall conduct source test(s) for the pollutant(s) identified below:

Pollutant(s) to be tested	Required Test Method(s)	Averaging Time	Test Location
CO emissions	District method 100.1, or approved District portable analyzer and test method	15 minutes	Outlet
NOX emissions	District method 100.1, or approved District portable analyzer and test method	15 minutes	Outlet
PM10 emissions	Approved District method	District-approved averaging time	Outlet

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The test(s) shall be conducted within 60 days after achieving maximum production rate, but no later than 180 days after initial start-up.

The test shall be conducted to demonstrate NO_x emission reduction by the installation of overfire air ports.

The test shall be conducted to demonstrate that there are no CO and PM₁₀ emission increases by the installation of overfire air ports.

In addition to the source test requirements of Section E of this facility permit, the facility permit holder shall submit the protocol to the AQMD engineer no later than 45 days prior to the proposed test date, and notify the District of the date and time of the test at least 10 days prior to the test.

During the source test(s), the facility permit holder shall also measure the oxygen and CO₂ levels in the exhaust, fuel flow rate (CFH), the flue gas rate, flue gas temperature, and sodium silicate production rate.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002; RULE 407, 4-2-1982; RULE 409, 8-7-1981]

[Devices subject to this condition: D18]

E193.1 The operator shall construct, operate and maintain this equipment according to the following requirements:

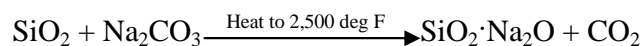
The operator shall notify the Administrator at least 60 days prior to changing the furnace from a furnace with modified processes to one without modified processes, or visa versa.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002; RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; 40 CFR Part 64, 10-22-1997]

[Devices subject to this condition: D18]

BACKGROUND/HISTORY

The PQ Corporation (The PQ Corp) produces sodium silicate (water glass) from soda ash and sand. Sodium silicate is used in a variety of products as a catalyst, an adhesive, in water treatment, in enhanced oil recovery, and in laundry detergent, among other operations. The chemical reaction is shown as following:



The resulting sodium silicate is in solid form and the company sells some of it at this point.

The PQ Corp operates under the NO_x and SO_x RECLAIM programs. In addition, the facility has a Title V permit. The current Title V Permit was issued for the facility on June 11, 2008. On July 16, 2008 and August 8, 2008, The PQ Corp submitted the following expedited applications:

<u>Application No.</u>	<u>Type</u>	<u>Previous Permit No.</u>	<u>Equipment</u>
485404	Modification	F6965	Furnace (D18)
486154	Plan	N/A	RECLAIM/TV Revision

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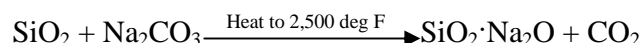
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A/N 485404 is submitted on July 16, 2008 as a Class-I modification application by changing the furnace firing system from single stage to dual stage. The proposed change is consisting of 1) lowering Air/Fuel ratio at existing burners, and 2) adding overfire air ports as the 2nd stage combustion. The change is expected to lower NO_x emissions by a minimum of 15% without increase any CO and VOC emissions. This project is initiated by the incentives to reduce purchasing of NO_x RTC under the RECLAIM program.

PROCESS DESCRIPTION*Existing furnace*

The melting furnace (D18) is used to produce sodium silicate (waterglass) by heating/melting a mixture of sand and soda ash. The chemical reaction is shown as following:



The existing furnace is a side port continuous regenerative furnace type. A drawing of this type furnace can be viewed as follows:

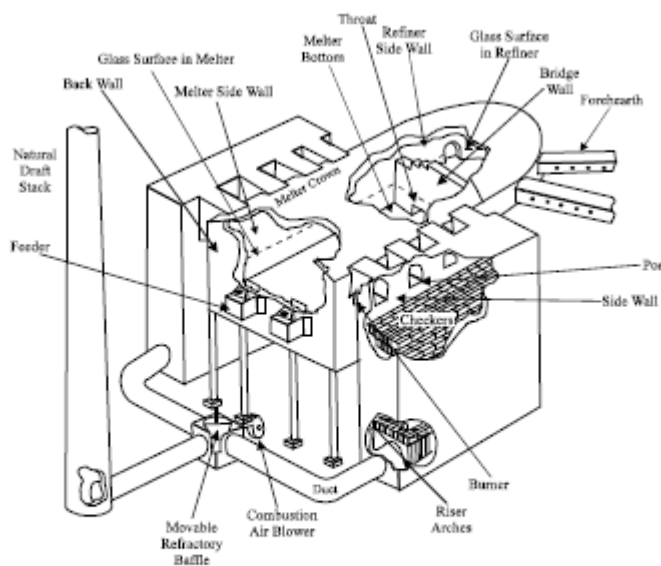


Figure 11.15-3. Side port continuous regenerative furnace.

Note: the above figure is obtained from AP-42, Chapter 11.15 page 11.15-3.

The furnace consists of a melter (combustion chamber) and two regenerators (firing side and exhaust side). Each regenerator side connects to the melter with five air ports and each air port has two burners. Combustion air is drawn in through the firing side regenerator, then through five air ports to the melter. The combustion air is mixed with the natural gas that is injected through the ten (10) burners located in the five air ports, and auto-ignited as soon as it enters the melter. The melter operation temperature is maintained at 2,500°F. The combustion exhaust is vented through the five air ports located at the other

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side of melter, then through the exhaust side regenerator to the stack. This process is maintained for a cycle of approximately 25 minutes, and then the next cycle will be the reversed direction of air flow, which means the previous cycle exhaust side becomes the firing side and the previous firing side becomes exhaust side. The heat preserved in the regenerator from previous cycle exhaust air will now be used to preheat incoming the combustion air during the new cycle. Typically, the combustion air can be heated up to 1800°F to 2000°F before it enters the melter, and the exhaust air has a temperature range between 800°F to 900°F. The exhaust stack is 150 feet elevated from ground.

Although the furnace physically contains a total of 20 burners (counted as two fuel burners in each air port, and five air ports each regenerator side and a total of two regenerator sides), only 10 burners can be operated during each firing cycle. Otherwise, counter current air flow will be introduced and the furnace will be burned down. Each burner is rated at 5 MMBtu/hr. Therefore, the firing rate is 5 MMBtu/hr \times 10 burners = 50 MMBtu/hr. These 20 burners do not have a pilot. Therefore, the furnace is equipped with two warm-up (start-up) burners, each rated at 3.3 MMBtu/hr, to pre-heat the melter to a minimal temperature of 1,400°F during a start-up. 1,400°F is the minimal temperature required to have an auto ignition at the primary burners. Once the 10 primary burners are ignited, the two warm-up burners will be shut-down (because they are not energy efficient). However, in order to be conservative, the total furnace firing rate will be expressed as follows:

No. of Burners		Each Burner Rating (MMBtu/hr)		Total Firing Rate (MMBtu/hr)
10	\times	5	=	50
2	\times	3.3	=	6.6
		Maximum Firing Rate	=	56.6 MMBtu/hr

Source Test Results

The PQ Corp had an annual compliance test performed on the furnace on May 13, 2008. The source test results indicated as follows:

NO_x @ 3% O₂ = 427.45 ppm

CO @ 3% O₂ = 4.82 ppm

PM emissions = 0.057 gr/dscf and 5.18 lb/hr

The majority of the PM emissions consist of the soda ash (Na₂CO₃), and minor combustion PM and sand (silicates) emissions.

Proposed modification

This modification project is to split the furnace combustion air supply into two stages. The current operating air/fuel ratio is 10.5. The new air/fuel ratio at the first stage will be between 8 and 9, and the remaining air will be injected into the furnace at second stage before air is exhausted to the stack. The overall air/fuel ratio will not be changed.

The project is to install a total of 20 overfire air lances (10 at each side of the melter), a blower and associated piping and PLC controls. The existing air/fuel ratio for the 10 primary burners is

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approximately 10.5. After the modification, approximately 80% of the combustion air (stoichiometric to the fuel supply) will be drawn in through the firing side regenerator, and the remaining 20% combustion air will be introduced directly into the melter (without being pre-heated) through 10 new overfire air lances located at the other side. This will create two combustion zones or so called stages within the melter.

The first stage, only a stoichiometric amount of combustion air (air/fuel ratio is at about 8-9) is drawn in through the firing side regenerator. This will make the fire longer, smokier, and more luminous as it is compared to the current firing method (air/fuel ratio = 10.5). According to a research, the NO_x formation at the stoichiometric air/fuel ratio is approximately 60% of it formed at a fire with an air/fuel ratio of 1.1 (see Figure 1 from the manufacture documentation). This is caused by reducing oxygen availability for thermal NO_x formation. At low excess air level (typical glass melter operated in the range of 2-5% excess O₂), the oxygen availability is the dominant factor of the thermal NO_x formation. However, at this stage, an increase in CO and unburned hydrocarbon (CH) concentrations will be resulted. Therefore, it is necessary to have the second stage, where the remaining combustion air is injected to the melter to complete the combustion process before it is exhausted to the stack.

The manufacture, Eclipse, guaranteed 15% NO_x reduction based on current normal operating conditions. The NO_x emission will not be calculated because the furnace is a major device equipped with CEMS, and is monitored under RECLAIM program. Rule 2012 requires the facility re-certify their CEMS if the new NO_x emissions fall out the 10-95 percent of the full scale span range. Based on a telephone conversation with the facility, the CEMS NO_x and O₂ span ranges are 0-5000 ppmV and 0 – 25%, respectively, and the current NO_x and O₂ emission ranges are 200-350 ppmV and 11.5-12.5%, respectively. Therefore, a 15% reduction of NO_x reduction will still within the 10-95 percent of the full scale span range, and re-certification of CEMS is not necessary.

In addition, Eclipse guarantee the CO emissions will not exceed 50 ppm at the stack. The current CO emission requirement based on Rule 407 is 2,000 ppmv. Therefore, in order to confirm compliance with this CO limit, a source test will be required in the Permit to Construct (Condition D29.1).

This project will not change the furnace rating, as well as no change to the production and/or material throughput. The exiting Condition C1.4 limits a material throughput of 263 tons/day and the furnace normally produces 150 to 200 tons/day waterglass. In addition, this project will not change the overall air/fuel ratio (10.5) and/or the total fuel usage for this furnace. The furnace will be operated 24 hr/day, 7 days/wk and 52 wk/yr.

Emissions:

This project is expected to have a 15% NO_x emission reduction from the furnace and the facility will report the NO_x emissions under the RECLAIM program. There will be no emission changes for the other combustion or process pollutants.

EMISSION CALCULATIONS

Operating Schedule (Max.):	24 hrs/day, 7 days/week, 52 weeks/yr
Fuel used:	Natural Gas
Natural Gas F-factor:	8,710 dscf/MMBtu @ 68°F and 29.92 in Hg



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Natural Gas Higher Heating Value: 1,050 Btu/scf (Regulation XX, Rule 2012, Table 3-D)

Maximum Load : 100%

Emission Factors

$$\text{Emission}_{\text{ROG,SOX,PM10}} (\text{lb/MMBtu}) = EF_{\text{ROG,SOX,PM10}} \left(\frac{\text{lb}}{\text{MMscf}} \right) \times \frac{1 \text{ MMscf}}{1050 \text{ MMBtu}}$$

$$\text{Emission}_{\text{NOX,CO}} (\text{lb/MMBtu}) = \frac{MW \times N_{@ 3\% O_2} \times \text{ppm}}{H}$$

Where: H= Heating value of fuel (Btu/lb) (for natural gas= 23,440 btu/lb)

N@3%O₂= 0.618 mole of dry gas per lb of natural gas.

MW= Molecular weight (lb/lb-mole)

Pollutant	Emission Factor (Source Test 5/13/08) ppmV @ 3% O ₂	Emission Factor (AQMD Default) lb/mmscf	Emission Factor (for this report) lb/MMBtu
VOC	-	5.5	0.00524
SO _x	-	0.6	0.000571
NO _x	427.45	-	0.5184
CO	4.82	-	0.00356

AQMD Default emission factors for natural gas fired external combustion equipment were taken from “General Instruction Book for the AQMD 2006-2007 Annual Emission Reporting Program”, Appendix A- Table 1.

In addition, the source test performed on May 13, 2008 indicated a total PM emissions of 5.18 lb/hr and 0.057 gr/dscf.

Open Hearth Burner rating: 56.6 MMBTU/hr

Operating Schedule: 24 hrs/day; 7 days/week; 52 weeks/yr

Assume: PM10 = 75% PM (This assumption is based on AP42 Chapter 11.15 page 9)

The calculated emission results for the pre-modification of the furnace are indicated below:

		Lb/hr	Lb/day	Lb/year	30 day ave.
R1=R2	VOC	0.297	7.12	2591.0	7.12
R1=R2	SO _x	0.0323	0.776	282.3	0.776
R1=R2	PM10	3.885	93.24	33939	93.24
R1=R2	PM	5.180	124.32	45252	124.32
R1=R2	NO _x	29.341	704.19	256327	704.19
R1=R2	CO	0.201	4.84	1760	4.84

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Emission Increase:

The proposed modification of the combustion process will result a minimal of 15% reduction of NO_x emissions, and no change with other air pollutants.

NO_x R1=R2 = (56.6 MMBtu/hr) (0.5184 lb/MMBtu) (1-15%) = 24.94 lb/hr or 598.56 lb/day

NO_x emission reduction = 29.34 lb/hr – 24.94 lb/hr = 4.4 lb/hr or 105.6 lb/day

Emission Summary

		Lb/hr	Lb/day	Lb/year	30 day ave.	30 day NSR
R1=R2	VOC	0.297	7.12	2,590.96	7.12	7
R1=R2	SO _x	0.0323	0.776	282.34	0.776	1
R1=R2	PM ₁₀	3.885	93.24	33,939.36	93.24	93
R1=R2	PM	5.180	124.32	45,252.48	124.32	124
R1=R2	NO _x	24.940	598.57	217,877.80	598.57	599
R1=R2	CO	0.201	4.84	1,760.27	4.84	5

RULES AND REGULATIONS EVALUATION

Rule 212: **Standards for Approving Permits** – The facility is not located within 1,000 feet of a K-12 school, and there is no emission increase associated with this modification. A Public Notice is not required.

Rule 401: **Visible Emissions** – Compliance is expected from well maintained and properly operated equipment.

Rule 402: **Public Nuisance** – The facility is located in a commercial/industrial area. The potential for public nuisance is minimal.

Rule 404: **Particulate Matter Concentration**
A source test was performed on May 13, 2008. The test results indicated a grain loading of 0.057 gr/dscf for a stack air flow of 10,557 dscfm. Table 404(a) allows a maximum concentration of PM 0.0773 grains/ft³ for a discharging rate of 10,557 CFM. Therefore, the furnace is in compliance.

The proposed modification will not result a change of PM emissions. Therefore, compliance is expected.

Rule 407: **Liquid and Gaseous Contaminants** – This rule limits the furnace to emit a maximum of CO level of 2000 ppmv. The manufacture guarantees CO emissions will not exceed 50 ppmv. This equipment was previously tested and resulted in a CO emission level of 4.82 ppmv @ 3% O₂. A source test has been stipulated on the Permit to Construct to verify CO emissions not exceed the level of 2000 ppmv after the modification.

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Rule 409: **Combustion Contaminants** – This rule limits the furnace to emit a maximum of PM level of 0.1 grain/cf @ 12% CO₂. This equipment was previously tested and resulted in a PM level of 0.057 grain/cf. A source test condition D29.1 has been stipulated on the Permit to Construct to verify PM emissions not exceed the level of 0.1 grain/cf @ 12% CO₂ after the modification.

Rule 1117: **Emissions of NO_x from Glass Melting Furnaces** – The subject furnace is a major device under NO_x RECLAIM program. Therefore, this rule does not apply.

REG XIII: **New Source Review**

- Rule 1303(a) – BACT

The facility is a major source for NO_x. The proposed modification of the furnace is expected to have no change with VOC, PM₁₀, CO and SO_x emissions. BACT is not required.

- Rule 1303(b)(2) – New Source Review Offsets

The proposed modification of the furnace is expected to have no change with VOC, PM₁₀, CO and SO_x emissions. Offset is not required.

In order to verify that there is no emission increase, a source test condition D29.1 has been stipulated on the Permit to Construct for the purpose of determining any increases in CO and PM emissions due to the modification to the furnace.

Rule 1401: There is no emission increase of the toxic air pollutants associated with this project. Risk assessment is not required.

RULE 2005: **New Source Review for RECLAIM**

The proposed modification of the furnace is estimated to have a NO_x emission reduction of 105.6 lb/day. No emission offset is required.

RULE 2012: **Requirements for Monitoring, Reporting, and Recordkeeping for Oxides of Nitrogen (NO_x) Emissions**

The protocol for Rule 2012 requires the CEMS installed on the subject furnace to have span ranges for NO_x and O₂ to be certified by the District, so that all data points gathered by the CEMS lie within 10% – 95% of the full scale span range. The certification of RECLAIM CEMS to the subject furnace was issued on June 27, 2006, and the span ranges are 0 – 500 ppm for NO_x and 0 – 25% for O₂.

The source test performed on May 13, 2008 shows the NO_x emissions at 231.60 ppm @ O₂ level of 11.22%. With an estimated 15% reduction of NO_x emissions, NO_x emissions will be 196.86 ppm @ O₂ level of approximately 11%. This still within the 10-95 percent of the full scale span ranges, and compliance is expected.

REG IX Subpart CC: **Standards of Performance for Glass Manufacturing Plants (40 CFR 60 Subpart CC)**

The subject furnace is a glass melting furnace and it is used to manufacture sodium silicate (water glass). Based on Hawley's Condensed Chemical Dictionary, sodium silicate is defined as "*Na₂·3.75SiO₂ to 2Na₂O·SiO₂ and with various proportions of water....* **The**

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simplest form of glass.” Therefore, the subject furnace appears to be subject to 40 CFR 60 Subpart CC. However, the furnace is only subject to 40 CFR 60.290 and 40 CFR 60.296(a).

40 CFR 60.290: Furnace is subject to 40 CFR 60 Subpart CC. Therefore, the Emissions and Requirements section of the Section H is revised to reflect this requirement.

40 CFR 60.296(a): requires notification if the furnace is modified such that emissions are minimized without the use of add-on pollution controls (called a furnace with modified processes), or if a furnace with modified processes is changed to a furnace without modified processes. If the facility performs such a modification, they are required to notify the Administrator at least 60 days before the change is scheduled to occur. The facility proposed modification of the burner by the installation of 20 overfire air ports, and this qualifies as such a change. Condition No. E193.1 for such notification for the proposed modification and/or future modification is added.

Reg XXX:**Title V Permit**

The PQ Corp (Facility ID: 11435) currently operates under Title V permit, which was issued for the facility on June 23, 2008. Based on the above evaluation, the proposed modification will not result an emission increase. Therefore, the permit revision application No. 485404 is considered a Minor Permit Revision of The PQ Corp’s Title V Facility Permit.

CONCLUSION AND RECOMMENDATIONS

Based on my evaluation, the subject equipment will operate in compliance with all applicable District Rules and Regulations. Permit to Construct is recommended.